

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

1                    Claim 1 (previously presented): A fast-search adaptive motion accuracy  
2 search method for estimating motion vectors in motion-compensated video coding by  
3 finding a best motion vector for a macroblock, said method comprising the steps of:

- 4                    (a)    searching a first set of motion vector candidates in a grid of  
5                                sub-pixel resolution of a predetermined square radius  
6                                centered on  $V_1$  to find a best motion vector  $V_2$  using a first  
7                                criteria;  
8                    (b)    searching a second set of motion vector candidates in a grid  
9                                of sub-pixel resolution of a predetermined square radius  
10                                centered on  $V_2$  to find a best motion vector  $V_3$  using a  
11                                second criteria;  
12                    (c)    searching a third set of motion vector candidates in a grid of  
13                                sub-pixel resolution of a predetermined square radius  
14                                centered on  $V_3$  to find said best motion vector of said  
15                                macroblock using a third criteria, and  
16                    (d)    wherein at least one of said first criteria, said second criteria,  
17                                and said third criteria is a rate-distortion criteria.

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1                    Claim 2 (original): The method of claim 1, said step of searching a first set  
2 of motion vector candidates in a grid of sub-pixel resolution of a predetermined square  
3 radius centered on  $V_1$  to find a best motion vector  $V_2$  further comprising the step of

4 searching a first set of eight motion vector candidates in a grid of 1/2-pixel resolution of  
5 square radius 1 centered on  $V_1$  to find a best motion vector  $V_2$ .

1 Claim 3 (original): The method of claim 1, said step of searching a second  
2 set of motion vector candidates in a grid of sub-pixel resolution of a predetermined  
3 square radius centered on  $V_2$  to find a best motion vector  $V_3$  further comprising the step  
4 of searching a second set of eight motion vector candidates in a grid of 1/6-pixel  
5 resolution of square radius 1 centered on  $V_2$  to find a best motion vector  $V_3$ .

1 Claim 4 (previously presented): The method of claim 1 further comprising  
2 the steps of using  $V_2$  as the motion vector for the macroblock if  $V_2$  has the smallest rate-  
3 distortion cost and skipping step (c) of claim 1.

1 Claim 5 (original): The method of claim 1, said step of searching a third  
2 set of motion vector candidates in a grid of sub-pixel resolution of a predetermined  
3 square radius centered on  $V_3$  to find said best motion vector of said macroblock further  
4 comprising the step of searching a third set of eight motion vector candidates in a grid of  
5 1/6-pixel resolution of square radius 1 centered on  $V_3$  to find said best motion vector of  
6 said macroblock.

1 Claim 6 (original): The method of claim 1, said step of searching a third  
2 set of motion vector candidates in a grid of sub-pixel resolution of a predetermined  
3 square radius centered on  $V_3$  to find said best motion vector of said macroblock further  
4 comprising the step of skipping motion vector candidates of said third set of motion  
5 vector candidates that have already been tested.

1 Claim 7 (original): The method of claim 1 further wherein said step of  
2 searching said first set of motion vector candidates further comprises the step of  
3 searching said first set of motion vector candidates using a first filter to do a first

4 interpolation, said step of searching said second set of motion vector candidates further  
5 comprises the step of searching said second set of motion vector candidates using a  
6 second filter to do a second interpolation, and said step of searching said third set of  
7 motion vector candidates further comprises the step of searching said third set of  
8 motion vector candidates using a third filter to do a third interpolation.

1 Claim 8 (previously presented): The method of claim 1, said step of  
2 searching a second set of motion vector candidates in a grid of sub-pixel resolution of a  
3 predetermined square radius centered on  $V_2$  to find a best motion vector  $V_3$  further  
4 comprising the steps of:

- 5 (a) searching three candidates of 1/3-pel accuracy  $V_2$  and a 1/2-  
6 pel location with the next lowest rate-distortion cost if  $V_2$  is at  
7 the center;
- 8 (b) searching four vector candidates of 1/3-pel accuracy that are  
9 closest to  $V_2$  if  $V_2$  is a corner vector; and
- 10 (c) determining which of two corners has lower rate-distortion  
11 cost and searching four vector candidates of 1/3-pel  
12 accuracy that are closest to a line between said corner with  
13 lower rate-distortion cost, if  $V_2$  is between two corners  
14 vectors.

1 Claim 9 (previously presented): An adaptive motion accuracy search  
2 method for estimating motion vectors in motion-compensated video coding by finding a  
3 best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching a first set of motion vector candidates in a grid  
5 centered on  $V_1$  using a first criteria to find a best motion  
6 vector  $V_2$  using a first filter to do a first interpolation;
- 7 (b) searching a second set of motion vector candidates in a grid  
8 centered on  $V_2$  using a second criteria to find a best motion

vector  $V_3$  using a second filter to do a second interpolation;  
and

- (c) searching a third set of motion vector candidates in a grid centered on  $V_3$  using a third criteria to find said best motion vector of said macroblock using a third filter to do a third interpolation;
- (d) wherein at least one of said first criteria, said second criteria, and said third criteria is a rate-distortion criteria.

Claim 10 (original): The method of claim 9 wherein said step of searching using a first filter to do a first interpolation further comprises using a simple filter to do a coarse interpolation.

Claim 11 (original): The method of claim 9 wherein said step of searching using a first filter to do a first interpolation further comprises using a simple filter to do a coarse interpolation and said step of searching using a second filter to do a second interpolation further comprises using a complex filter to do a fine interpolation.

Claim 12 (original): The method of claim 11 wherein said step of searching using a third filter to do a third interpolation further comprises using a complex filter to do a fine interpolation.

Claim 13 (original): The method of claim 9 wherein said step of searching using a first filter to do a first interpolation further comprises using a bilinear filter to interpolate the reference frame by 2x2.

Claim 14 (original): The method of claim 9 wherein said step of searching using a first filter to do a first interpolation further comprises using a bilinear filter to interpolate the reference frame by 2x2 and said step of searching using a second filter

4 to do a second interpolation further comprises using a cubic filter to do a fine  
5 interpolation.

1 Claim 15 (original): The method of claim 14 wherein said step of  
2 searching using a third filter to do a third interpolation further comprises using a cubic  
3 filter to do a fine interpolation.

1 Claim 16 (previously presented): An adaptive motion accuracy search  
2 method for estimating motion vectors in motion-compensated video coding by finding a  
3 best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching at a first motion accuracy for a first best motion  
5 vector of said macroblock;
- 6 (b) encoding said first best motion vector and said first motion  
7 accuracy;
- 8 (c) searching for at least one second best motion vector of said  
9 macroblock at an at least one second motion accuracy;
- 10 (d) encoding said at least one second best motion vector and  
11 said at least one second motion accuracy; and
- 12 (e) selecting the best motion vector of said first and at least one  
13 second best motion vectors using rate-distortion criteria.

1 Claim 17 (original): The method of claim 16 wherein said step of selecting  
2 the best motion vector using rate-distortion criteria further comprises the step of said  
3 rate-distortion criteria adapting according to the different motion accuracies to determine  
4 both the best motion vectors and the best motion accuracies.

1 Claim 18 (original): The method of claim 16, said step of searching for at  
2 least one second best motion vector at an at least one second motion accuracy further  
3 comprising the step of searching for at least one second best motion vector of said

4 macroblock at an at least one second motion accuracy that is finer than said first motion  
5 accuracy.

1 Claim 19 (original): The method of claim 16 wherein said step of selecting  
2 the best motion vector using rate-distortion criteria further comprises the step of using  
3 rate-distortion criteria of the type "distortion + L\*Bits" to select the best motion vector.

1 Claim 20 (previously presented): An adaptive motion accuracy search  
2 method for estimating motion vectors in motion-compensated video coding by finding a  
3 best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching at a motion accuracy for a best motion vector of  
5 said macroblock using rate-distortion criteria;
- 6 (b) encoding said motion accuracy using a code from a VLC  
7 table that is interpreted differently at different coding units  
8 according to the associated motion vector accuracy; and
- 9 (c) encoding said best motion vector in the respective accuracy  
10 space.

1 Claim 21 (previously presented): A system for estimating motion vectors  
2 in motion-compensated video coding by finding a best motion vector for a macroblock,  
3 said system comprising:

- 4 (a) a first encoder for searching a first set of motion vector  
5 candidates in a grid of sub-pixel resolution of a  
6 predetermined square radius centered on  $V_1$  using a first  
7 criteria to find a best motion vector  $V_2$ ;
- 8 (b) a second encoder for searching a second set of motion  
9 vector candidates in a grid of sub-pixel resolution of a  
10 predetermined square radius centered on  $V_2$  using a second  
11 criteria to find a best motion vector  $V_3$ ; and

- 12 (c) a third encoder for searching a third set of motion vector  
13 candidates in a grid of sub-pixel resolution of a  
14 predetermined square radius centered on  $V_3$  using a third  
15 criteria to find said best motion vector of said macroblock;  
16 (d) wherein at least one of said first criteria, said second criteria,  
17 and said third criteria is a rate-distortion criteria.

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1 Claim 22 (original): The system of claim 21 wherein said first, second,  
2 and third encoders are a single encoder.  
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1 Claim 23 (previously presented): A fast-search adaptive motion accuracy  
2 search method for estimating motion vectors in motion-compensated video coding by  
3 finding a best motion vector for a macroblock, said method comprising the steps of:

- 4 (a) searching a first set of motion vector candidates in a grid of  
5 sub-pixel resolution of a predetermined square radius  
6 centered on  $V_1$  to find a best motion vector  $V_2$ ;  
7 (b) searching a second set of motion vector candidates in a grid  
8 of sub-pixel resolution of a predetermined square radius  
9 centered on  $V_2$  to find a best motion vector  $V_3$ ;  
10 (c) searching a third set of motion vector candidates in a grid of  
11 sub-pixel resolution of a predetermined square radius  
12 centered on  $V_3$  to find said best motion vector of said  
13 macroblock, and  
14 (d) using  $V_2$  as the motion vector for the macroblock if  $V_2$  has the  
15 smallest rate-distortion cost and skipping step (c).  
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1 Claim 24 (previously presented): The method of claim 1, wherein said first  
2 criteria, said second criteria, and said third criteria are all rate-distortion criteria.  
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1                   Claim 25 (previously presented): The method of claim 9, wherein said first  
2 criteria, said second criteria, and said third criteria are all rate-distortion criteria.  
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1                   Claim 26 (currently amended): The system of ~~claim 21~~, claim 21, wherein  
2 said first criteria, said second criteria, and said third criteria are all rate-distortion criteria.  
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